INSTRUCTIONS

STEEL-CROWN PISTONS
GE DIESEL ENGINES

FIG. 1, E-16196A

CONTENTS

	Page
SPECIAL TOOLS	1
DESCRIPTION	1
PISTON RING WEAR	1
MEASURING RATE OF PISTON RING WEAR	2
RENEWING PISTON RINGS	2
PISTON INSPECTION	3
BUSHING REPLACEMENT	
USING STANDARD BUSHING	4
USING BUSHING WITH OVERSIZE O.D.	5
CROWN REMACHINING	5
SKIRT REMACHINING	5
PISTON ASSEMBLY	5
DATA	6
TORQUE VALUES	7

SPECIAL TOOLS

Piston Ring Groove Scraper	147X1098
Piston Ring Expander	147X1099
Standard Ring Gage	137X1031

DESCRIPTION

Each piston is an assembly of a steel crown and an aluminum skirt. The two sections are held together with four bolts.

In cross-section the steel crown is circular, but the aluminum skirt is oval; with the long axis perpendicular and the short axis parallel to the piston pin bore. The skirt is also barrel-shaped from F to G on the short axis, Fig. 5.

The piston pin bore contains a steel-backed precision bushing with an interference fit in the bore.

Three compression ring grooves are located in the crown and the oil ring groove is located in the skirt. Four radially drilled drain holes, from the oil ring groove into the lower cavity of the skirt, permit oil, scraped off the walls by the oil ring, to return to the crankcase, Fig.,1.

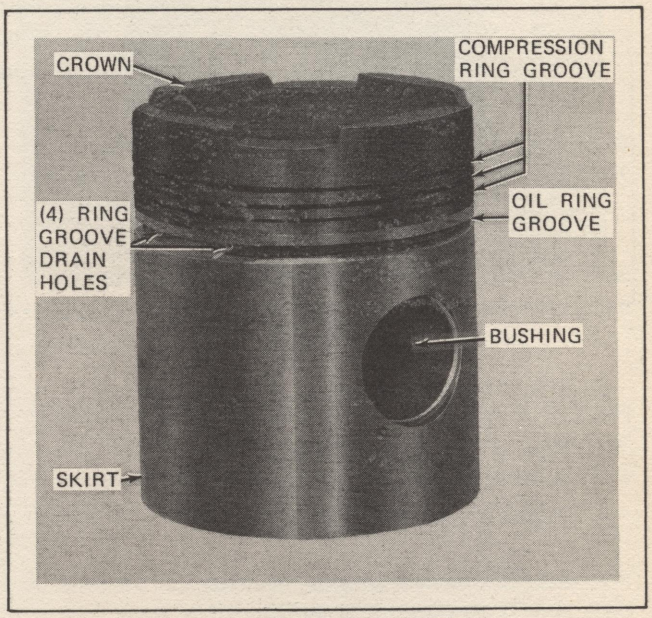


FIG. 1. PISTON ASSEMBLY.

Two cooling-oil holes lead from inside the piston pin bore to the outside cavity of the crown. Oil then circulates in the outside cavity, passes to the center cavity of the crown through eight holes in the annular support and bolting ring on the underside of the crown, and finally to the crankcase through two drain holes, Fig. 2.

PISTON RING WEAR

Ring wear is the result of many factors, some of which are as follows:

1. Type of service and terrain

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

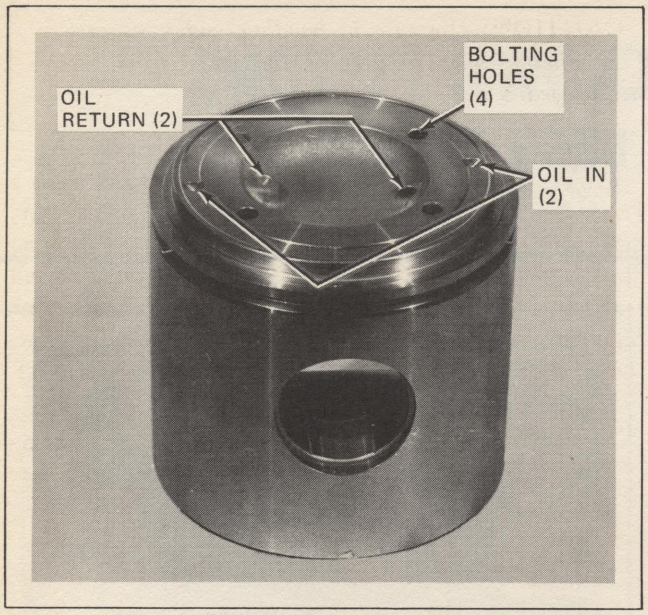


FIG. 2. PISTON SKIRT.

2. Effectiveness of engine air filter maintenance

3. Type of fuel and lube oil used

4. Degree of lube-oil control

5. General quality of engine maintenance.

Because of these factors, it is impossible to coordinate the rate of ring wear with engine operating time or locomotive miles traveled under all conditions. Therefore, for best economy, the rate of ring wear and thus the ring renewal periods can be determined best after a period of service under actual operating conditions.

For most efficient operation and best economy, it is recommended that piston rings, removed from an engine for any reason, be discarded and new rings applied. Any sticking rings or rings which show scuffing, burning or other abnormal conditions MUST be renewed regardless of wear.

MEASURING RATE OF PISTON RING WEAR

At the first opportunity, measure ring wear on one complete set of rings as follows:

1. Clean and insert the ring to be measured into the standard ring gage (Part 147X1031), Fig. 3. Make sure the ring is seated squarely in the gage.

2. Using a feeler gage, measure the ring end-gap and record the reading.

Ring wear rate should be determined on at least the first two locomotives of a group. The information gained should

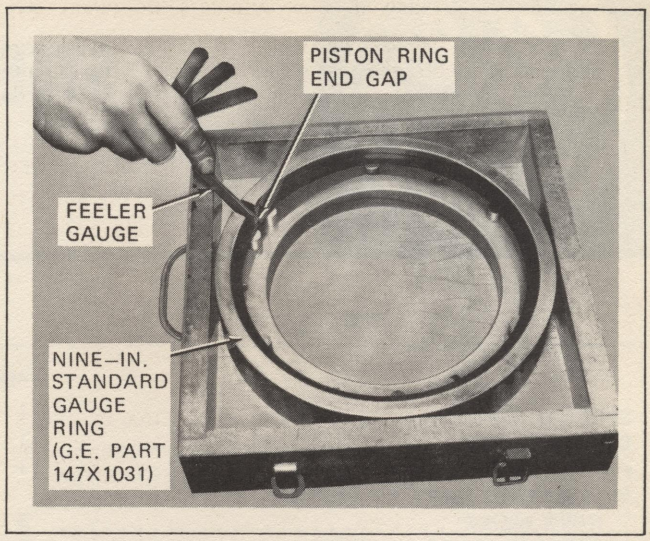


FIG. 3. METHOD OF CHECKING PISTON RING WEAR.

be used to adjust the existing maintenance schedule to insure ring renewal for the complete group of locomotives before ring wear becomes excessive.

Determine the approximate rate of ring wear by dividing the increase in ring gap by the total miles or hours operated since rings were installed. The increase in gap is the actual measured gap less the minimum gap given in the DATA section.

RENEWING PISTON RINGS

CAUTION: *Cylinder scoring and severe shortening of ring and liner life will result if chrome rings are used with chrome liners or iron rings with tufftrided liners. Refer to your Renewal Parts Catalog for the proper ring and liner combinations. See Fig. 4.*

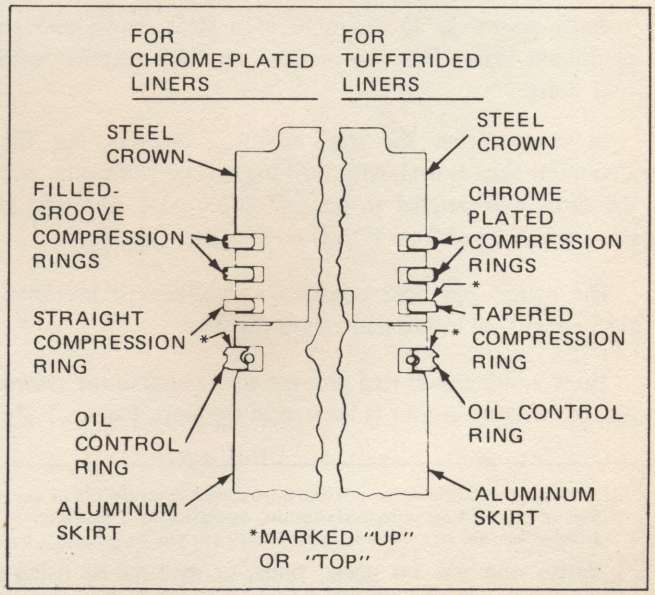


FIG. 4. PISTON RING ARRANGEMENTS.

*Revisions are indicated by marginal bars.

FIG. 2, E-16197B
FIG. 3, E-10013
FIG. 4, E-21062

Rings may be renewed after cylinders are taken off, without removing the pistons from the engine. When on or near top dead center, the pistons extend above the engine main frame. To renew rings, proceed as follows:

1. After the old rings are removed, clean the ring grooves to assure full ring side clearance. The ring scraper tool, Part 147X1098, should be used to clean carbon from the ring grooves.

CAUTION: *Care must be exercised when removing carbon so the ring grooves do not become damaged.*

   Insure foreign material does not enter the crankcase. Dirt and cleaning materials from groove cleaning can cause serious damage to bearings and other internal engine parts.

2. When installing rings, always use the ring expander tool, Part 147X1099, to prevent permanent distortion of the rings.

3. Install the oil-control ring first. Assemble the expander spring in the ring groove. Then, place the ring, SCRAPING EDGES DOWN, over the expander spring, and in its groove. Position the oil-ring end gap 180 degrees from the expander spring joint.

4. Install the compression rings as indicated by their markings. Rings not marked may be installed with either side up.

5. Assure all rings fit freely in their grooves at all positions around the piston. Then stagger the end gaps of adjacent rings approximately 90 degrees with no two in line.

PISTON INSPECTION

Whenever a cylinder is removed, inspect the piston for cracks, galling, scoring and hot spots. Examine the piston rings for cracks, hot spots and unusual wear patterns. At the interval prescribed in the Inspection and Maintenance Schedule, Tab RM-2, remove the pistons from the engine and separate the crown from the skirt.

NOTE: *The interval specified is based upon the use of a recommended lube oil. Using inferior oils or operating at high temperature may require separating the crowns and skirts more frequently. High temperature operation causes excessive buildup of carbon in the crown cooling cavities. This reduces the cooling effect of the lube oil and may lead to crown failure.*

CAUTION: *Use care in handling and transporting aluminum skirts to prevent the metal from being damaged.*

Crowns and skirts do not have to be kept together as a set. If a new skirt is mated with a used crown, or vice versa, make sure the rabbet fit on the used part is round and dimensionally correct. See DATA section. Pistons removed from the engine may be reused if defects found during the following inspection procedure do not exceed the limits shown in the DATA section.

1. Thoroughly clean all parts before inspecting or taking measurements. Clean the carbon from the underside of the crown.

   Do not use glass beads or any other abrasives to clean the skirt. The skirt, with bushing, should be steam cleaned to remove oil and dirt.

2. Measure the crown diameters at locations A, B, C and D, Fig. 5. Also measure the skirt diameters, perpendicular to the piston pin bore, at locations E, F and G.

3. Measure the width of the ring grooves and check for wear steps at the bottom of the grooves. If wear steps are present, cut them out, removing as little metal as possible. See the DATA section for maximum width.

4. Magnaflux* the crown and Zyglo* the skirt. If any indication of cracks, porosity or nicks exceeding 1/32 in. (0,75 mm) in depth is detected, the piece cannot be reused. Any crack less than 1/32 in. deep should be ground out and blended into the surface, eliminating any abrupt change in contour.

5. Magnaflux the piston pin. Slight nicks and blemishes may be stoned out and blended smooth if they are neither over 1/2 in. (13 mm) in surface diameter nor more than 1/32 in. (0,75 mm) deep. See the DATA section for wear limits.

6. Check the running clearance of the piston pin to the bushing. If it is within the limits specified in the DATA section and the bushing is free of cracks, scores, heat discoloration and pitting, reuse both the pin and bushing in the same relationship end-for-end. Do not mistake the tabs in the bail area for cracks. If the bushing must be replaced, observe the following:

*Registered trademarks of Magnaflux Corporation.

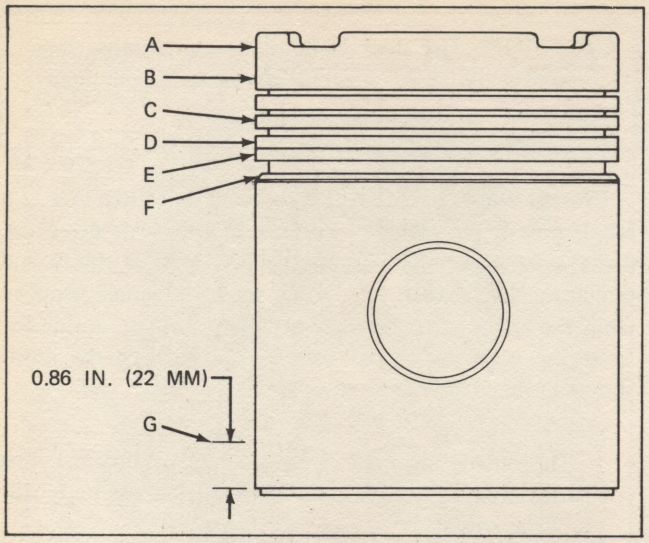


FIG. 5. PISTON MEASURING POINTS.

BUSHING REPLACEMENT

USING STANDARD BUSHING

NOTE: *Since special heating and cooling equipment and special boring equipment are required to replace a bushing, it may be advantageous for some customers to use factory finished skirt and bushing assemblies. Refer to the Renewal Parts Catalog.*

Replacing a Piston Bushing

1. Using a hacksaw blade, carefully cut the old bushing wall almost through in the area of the bails, Fig. 6. Remove the bushing, using care to prevent damage to the skirt bore.

2. Clean the new bushing and the skirt bore.

3. Freeze the bushing to minus 100 to 140 degrees F (minus 73 to 96 degrees C). Heat the skirt to 300 to 325 degrees F (149 to 163 degrees C). Carefully position the bushing in its bore in the skirt.

CAUTION: *Do not heat the skirt over 325 F (163 C) and do not hold this temperature over one hour or permanent damage to the physical qualities of the skirt will result.*

4. After the bushing and skirt have reached room temperature, machine the pin bore to the dimensions given in Fig. 6. After machining remove all sharp edges, clean the pin bore, and check the quality of the boring operation by inserting the piston pin with Prussian Blue applied. See DATA section for the required contact area.

5. Check with a feeler gage for the running clearance between the bushing and pin. Correct clearance is given in the DATA section.

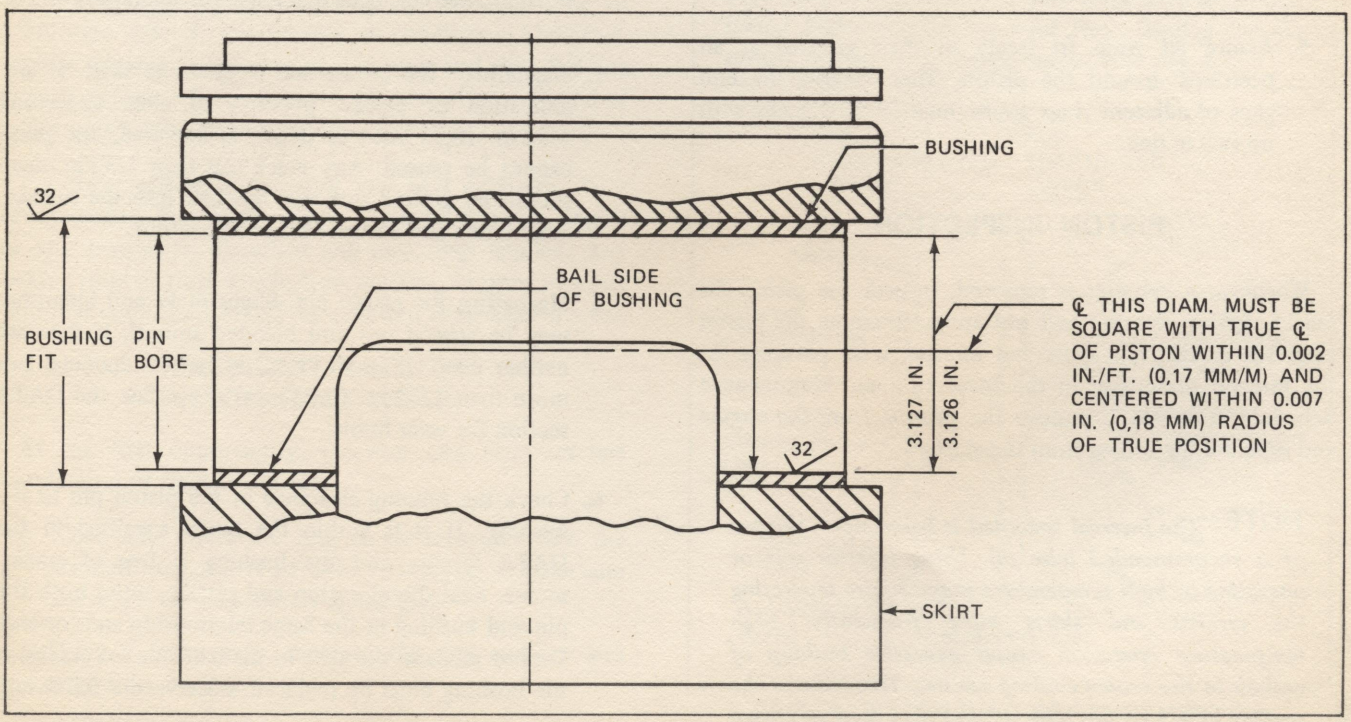


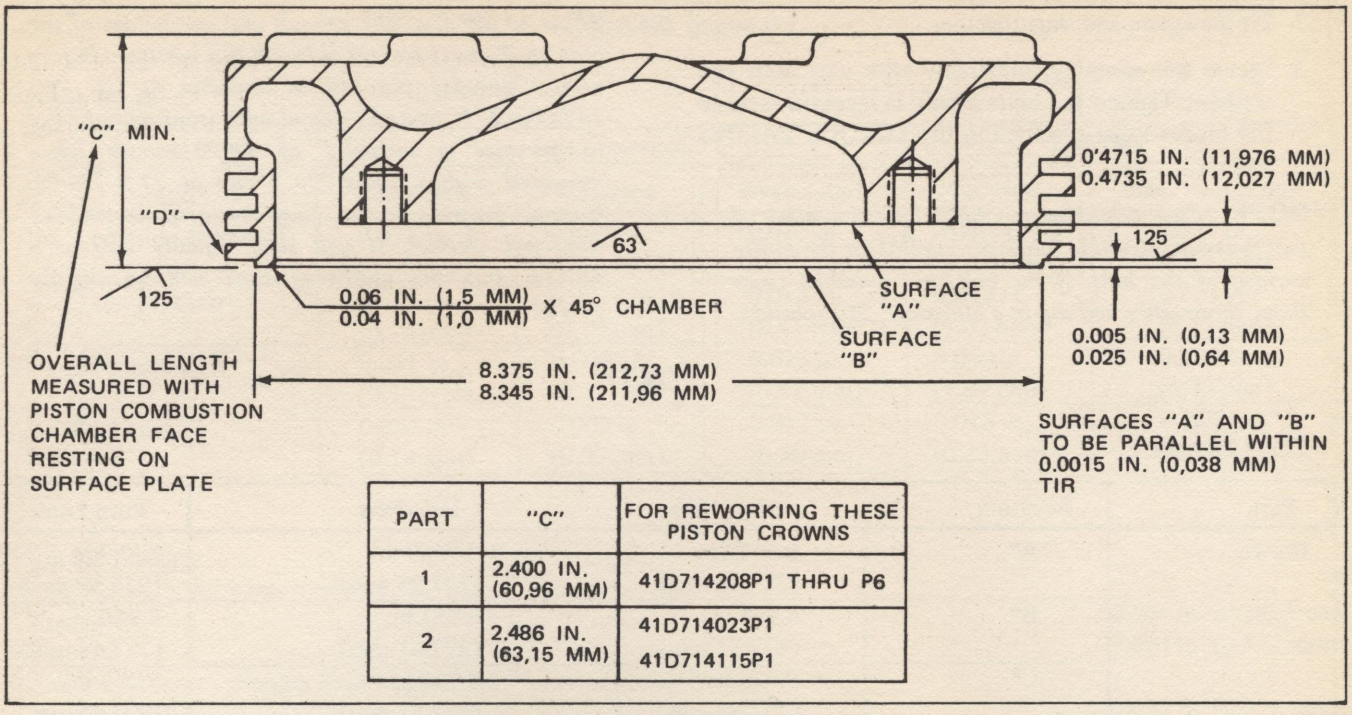
FIG. 6. BUSHING DETAILS.

FIG. 5, E-16195A

FIG. 6, E-16194B

FIG. 7, E-24775

FIG. 8, E-24776


"C" MIN.
"D"
125
63
0.06 IN. (1,5 MM)
0.04 IN. (1,0 MM) X 45° CHAMBER
SURFACE "A"
SURFACE "B"
0'4715 IN. (11,976 MM)
0.4735 IN. (12,027 MM)
125
0.005 IN. (0,13 MM)
0.025 IN. (0,64 MM)
OVERALL LENGTH MEASURED WITH PISTON COMBUSTION CHAMBER FACE RESTING ON SURFACE PLATE
8.375 IN. (212,73 MM)
8.345 IN. (211,96 MM)
SURFACES "A" AND "B" TO BE PARALLEL WITHIN 0.0015 IN. (0,038 MM) TIR

PART	"C"	FOR REWORKING THESE PISTON CROWNS
1	2.400 IN. (60,96 MM)	41D714208P1 THRU P6
2	2.486 IN. (63,15 MM)	41D714023P1 41D714115P1

FIG. 7. CROWN REMACHINING DETAILS.

USING BUSHING WITH OVERSIZE O.D.

1. Rebore the bushing fit to 3.401-3.402 in. (86,39-86,41 mm) diameter.

2. Use Part 142X1042 bushing and install using the same procedure as in Steps 2 through 5 under Using Standard Bushing section.

CROWN REMACHINING

Steel crowns may be remachined if fretting is observed on surfaces "A" or "B," Fig. 7. Both surfaces should be remachined to maintain the proper step dimension.

NOTE: *The drawing number is located on surface "D," Fig. 7. The drawing number for the skirt is located on the bottom face of the skirt. A serial number is stamped inside the skirt in the area of the bail support. This is for disassembly information only. For ordering parts, see the Renewal Parts Catalog.*

SKIRT REMACHINING DETAILS

Skirts may be remachined if surfaces "A" or "B," Fig. 8, are fretted. Surface "A" must be perpendicular to the true center line through the contoured portion of the skirt within 0.0025 in. (0,064 mm) TIR. Note that surface "B" is a large, obtuse angle with respect to surface "A," which is a square shoulder.

PISTON ASSEMBLY

1. Thoroughly clean the mating surfaces of the crown and skirt. Apply a light film of molybdenum-disulfide lubricant, Hercules* Moly-Duolube No. 69, or equivalent, to the top surface of the piston skirt (surface "B," Fig. 8).

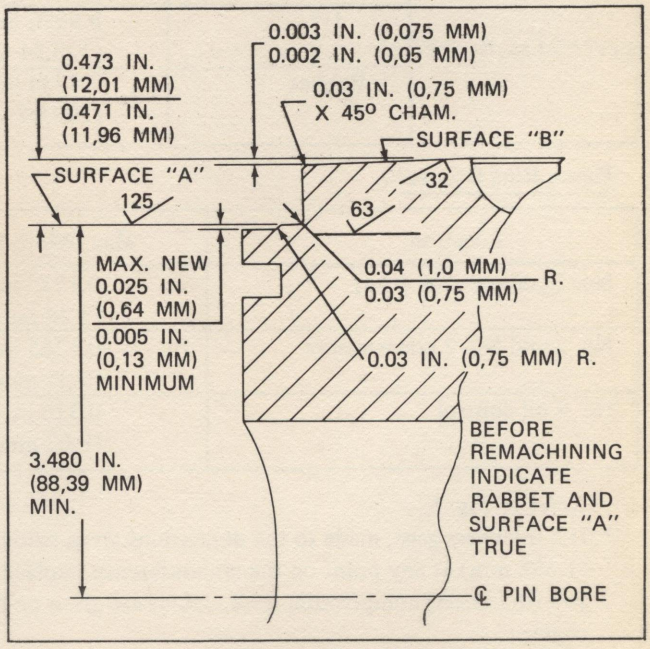


FIG. 8. SKIRT REMACHINING DETAILS.

*Product of the Richardson Company.

2. Fit the crown and skirt together.

3. Secure the assembly, preferably with new bolts and washers. Tighten the bolts evenly in increments up to the torque value specified in the TORQUE VALUES section.

NOTE: *Current-production bolts have a coating of molybdenum-disulfide lubricant applied to the entire surface of the bolt. If the bolts are reusable, clean them thoroughly and dip in a Molydag* 210 solution. Allow to air dry. The threads and undersides of the bolt heads must be covered with this lubricant before using. Molydag No. 210 is available as GE Part 147X1613. It must be mixed with isopropyl alcohol to produce a viscosity of 60-90 seconds when measured with a Zahn No. 1 cup at 77 F (25 C). Normal propyl alcohol may be used instead of isopropyl alcohol. It will serve equally well as a solvent, but the air-drying time will be slightly extended.*

DATA

Piston Diameters

Part	Location	Max.-New	Min.-New	Worn Limit
Crown	A*	8.9519 in. (227,38 mm)	8.9469 in. (227,25 mm)	8.870 in. (225,30 mm)
	B*	8.965 in. (227,71 mm)	8.961 in. (227,61 mm)	8.956 in. (227,48 mm)
	C*	8.973 in. (227,91 mm)	8.969 in. (227,81 mm)	8.963 in. (227,66 mm)
	D*	8.920 in. (226,57 mm)	8.910 in. (226,31 mm)	
	Rabbet	7.876 in. (200,05 mm)	7.874 in. (200,00 mm)	
		Perpendicular To Piston Pin Bore		
Skirt	E*	8.973 in. (227,91 mm)	8.969 in. (227,81 mm)	8.964 in. (227,69 mm)
	F*	8.978 in. (228,04 mm)	8.976 in. (227,99 mm)	8.969 in. (227,81 mm)
	G*	8.9896 in. (228,34 mm)	8.9876 in. (228,29 mm)	8.981 in. (228,12 mm)
	Rabbet	7.8734 in. (199,98 mm)	7.8724 in. (199,96 mm)	

Piston Ring Grooves

Location	Max. Width-New	Min. Width-New	Worn Limit**
No. 1 compression (top)	0.1275 in. (3,24 mm)	0.126 in. (3,20 mm)	0.1305 in. (3,31 mm)
No. 2 and No. 3 compression	0.1265 in. (3,21 mm)	0.125 in. (3,18 mm)	0.1305 in. (3,31 mm)
No. 4 oil control	0.316 in. (8,03 mm)	0.3145 in. (7,99 mm)	0.324 in. (8,23 mm)

*Refer to Fig. 5.

**If a thickness gage, made to the dimensions given below, enters any of the compression ring grooves more than 1/16 in. (1,588 mm) at any point on the circumference, replace the steel crown. Steel crowns can be remachined to use oversize (thickness) compression rings; details are given on drawing 41C615441 obtained thru the local field service engineer.

*Product of Acheson Colloids Co.

DATA (Cont'd.)

Piston Rings

	Side Clearance			End Gap	
Location	Max.-New	Min.-New	Worn Limit	Min.-New	Max.-Worn Limit
No. 1 compression (top)	0.013 in. (0,33 mm)	0.0085 in. (0,22 mm)	0.016 in. (0,41 mm)	0.040 in. (1,02 mm)	0.225 in. (5,72 mm)
No. 2 compression	0.012 in. (0,30 mm)	0.0075 in. (0,19 mm)	0.016 in. (0,41 mm)	0.040 in. (1,02 mm)	0.225 in. (5,72 mm)
No. 3 compression	0.011 in. (0,28 mm)	0.0065 in. (0,17 mm)	0.016 in. (0,41 mm)	0.040 in. (1,02 mm)	0.225 in. (5,72 mm)
No. 4 oil control	0.007 in. (0,18 mm)	0.002 in. (0,05 mm)	0.012 in. (0,30 mm)	0.013 in. (0,33 mm)	0.225 in. (5,72 mm)

Piston Pin Bushing

Interference fit – bushing to skirt

- Minimum . . . . . 0.004 in. (0,102 mm)
- Maximum . . . . . 0.007 in. (0,178 mm)

Running clearance – bushing to pin (minimum 75 percent blue fit)

- Minimum-new . . . . . 0.003 in. (0,076 mm)
- Maximum-new . . . . . 0.0045 in. (0,114 mm)
- Worn limit . . . . . 0.007 in. (0,178 mm)

Piston Pin

Bearing diameter

- Maximum-new . . . . . 3.123 in. (79,32 mm)
- Minimum-new . . . . . 3.1225 in. (79,31 mm)
- Worn limit . . . . . 3.120 in. (79,25 mm)

TORQUE VALUES

Crown-skirt bolts . . . . . 45-55 lb.-ft. (61-75 N·m)